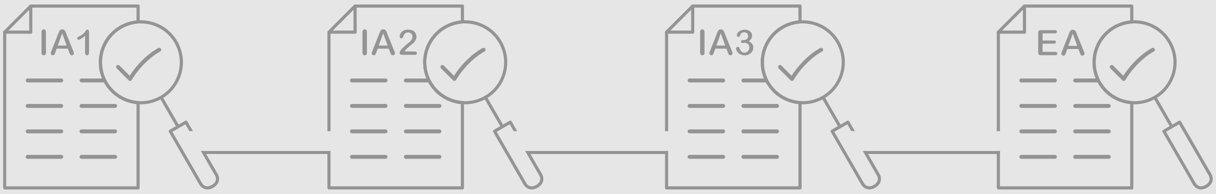
Engineering subject report

2025 cohort

January 2026



Queensland Government
QCAA
Queensland Curriculum & Assessment Authority
260042

For all Queensland schools

Queensland Curriculum & Assessment Authority
PO Box 307 Spring Hill QLD 4004 Australia

Phone: (07) 3864 0299
Email: office@qcaa.qld.edu.au
Website: www.qcaa.qld.edu.au

Contents

Introduction

The annual subject reports seek to identify strengths and opportunities for improvement of internal and external assessment processes for all Queensland schools. The 2025 subject report is the culmination of the partnership between schools and the QCAA. It addresses school-based assessment design and judgments, and student responses to external assessment for General and General (Extension) subjects. In acknowledging effective practices and areas for refinement, it offers schools timely and evidence-based guidance to further develop student learning and assessment experiences for 2026.

The report also includes information about:

- how schools have applied syllabus objectives in the design and marking of internal assessments
- how syllabus objectives have been applied in the marking of external assessments
- patterns of student achievement
- important considerations to note related to the revised 2025 syllabus (where relevant).

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples that demonstrate best practice.

Schools are encouraged to reflect on the effective practices identified for each assessment, consider the recommendations to strengthen assessment design and explore the authentic student work samples provided.

Audience and use

This report should be read by school leaders, subject leaders, and teachers to:

- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for internal and external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can use it to learn about the assessment practices and outcomes for senior subjects.

Subject highlights

108
schools offered Engineering

95.07%
of students received a C or higher

12.33%
increase in enrolment since 2024

Subject data summary

Unit completion

The following data shows students who completed the General subject.

Note: All data is correct as at January 2026. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered Engineering: 108.

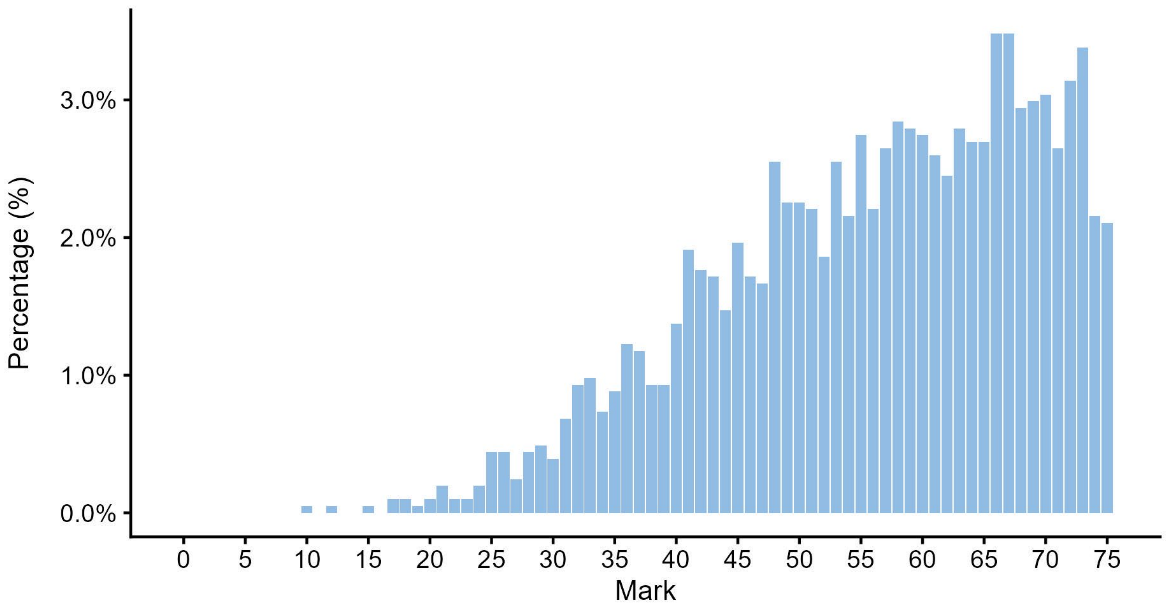
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	2,381	2,203	2,030

Units 1 and 2 results

Number of students	Unit 1	Unit 2
Satisfactory	2,153	2,059
Unsatisfactory	228	144

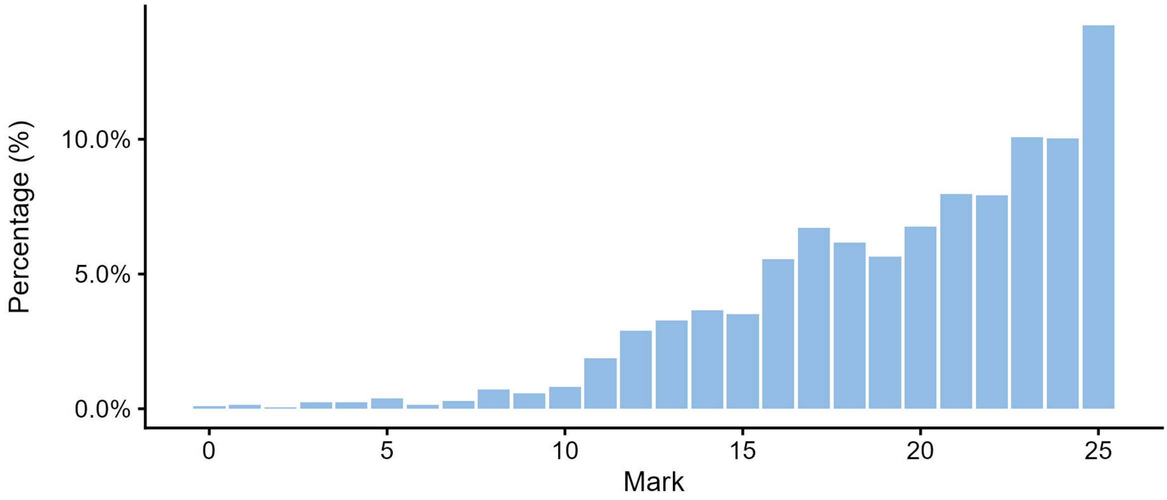
Units 3 and 4 internal assessment (IA) results

Total marks for IA

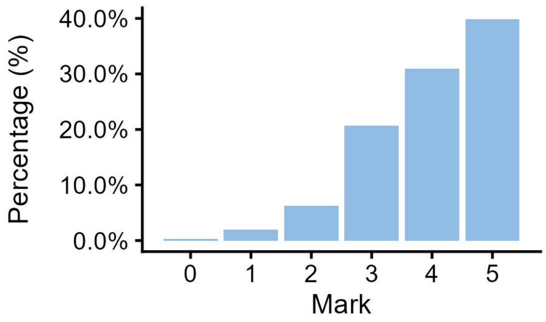


IA1 marks

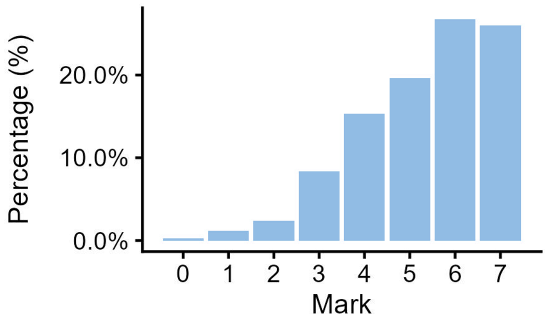
IA1 total



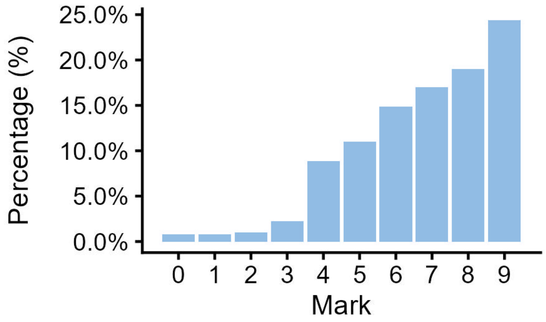
IA1 Criterion: Retrieving and comprehending



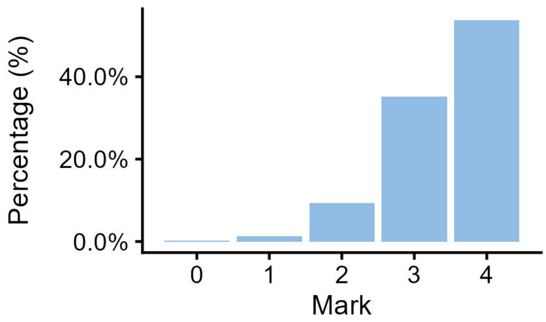
IA1 Criterion: Analysing



IA1 Criterion: Synthesising and evaluating

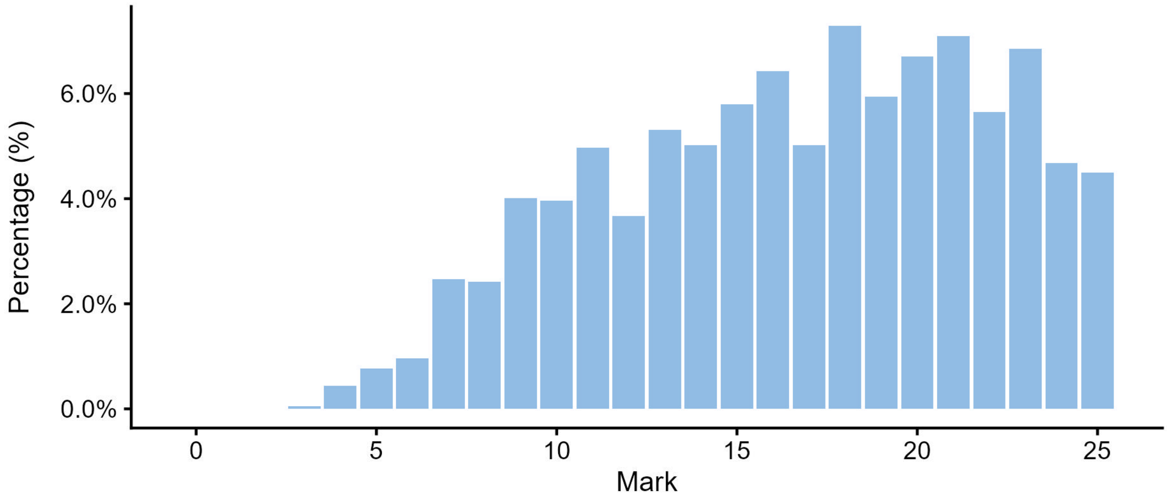


IA1 Criterion: Communicating

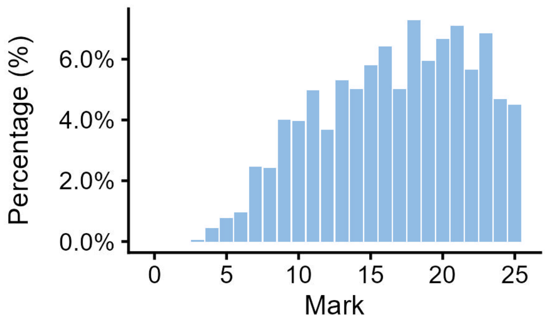


IA2 marks

IA2 total

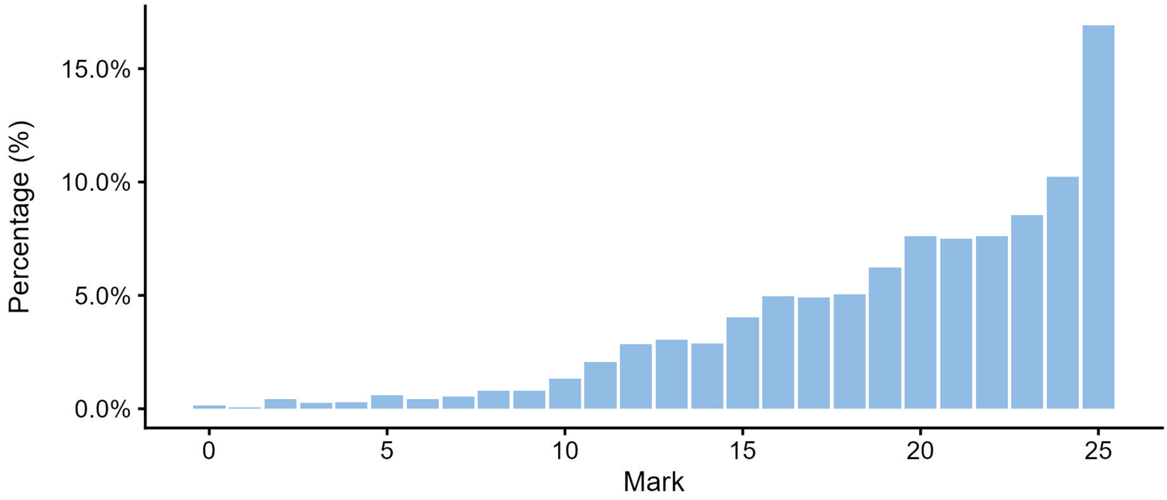


IA2 Criterion: Engineering knowledge and problem-solving

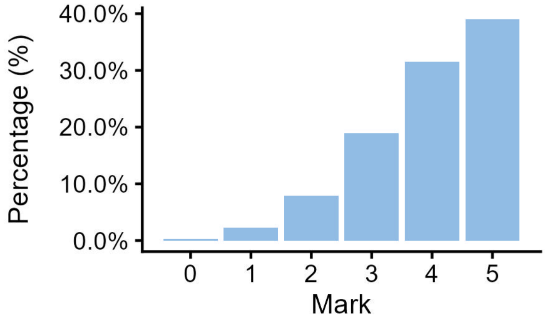


IA3 marks

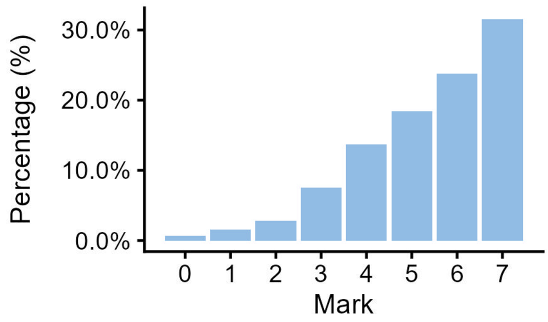
IA3 total



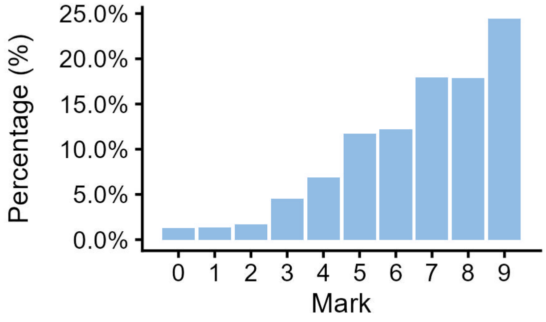
IA3 Criterion: Retrieving and comprehending



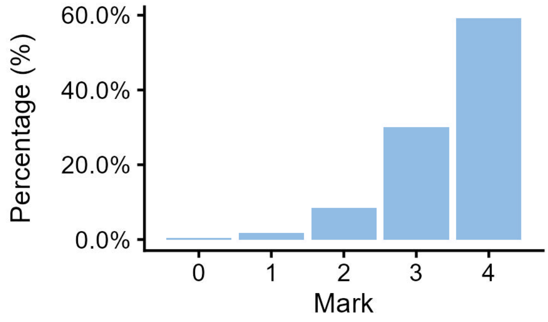
IA3 Criterion: Analysing



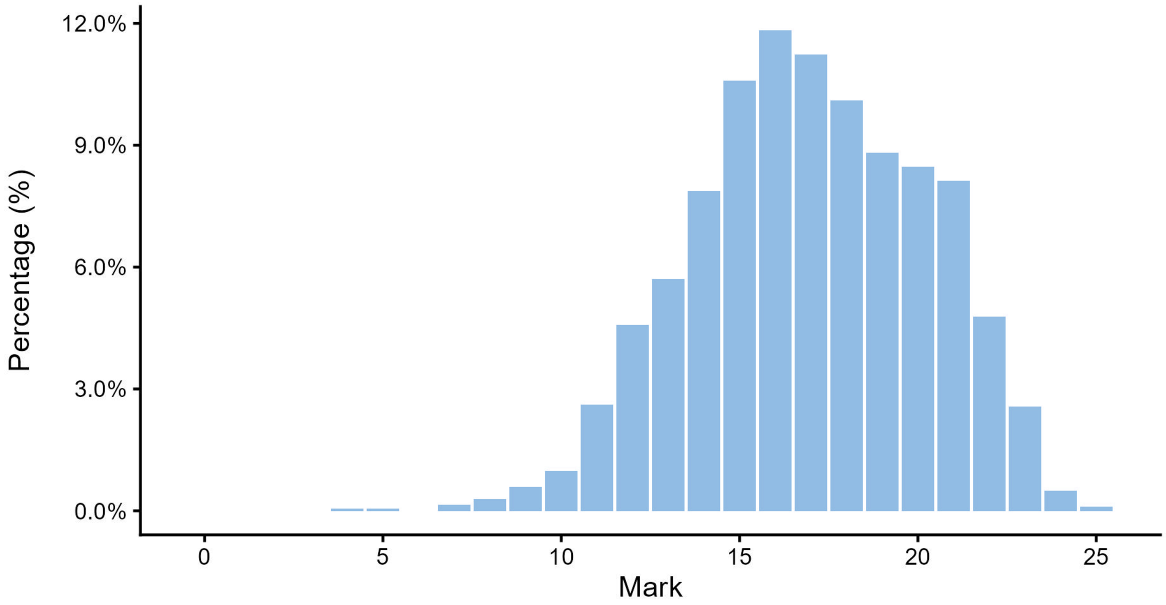
IA3 Criterion: Synthesising and evaluating



IA3 Criterion: Communicating

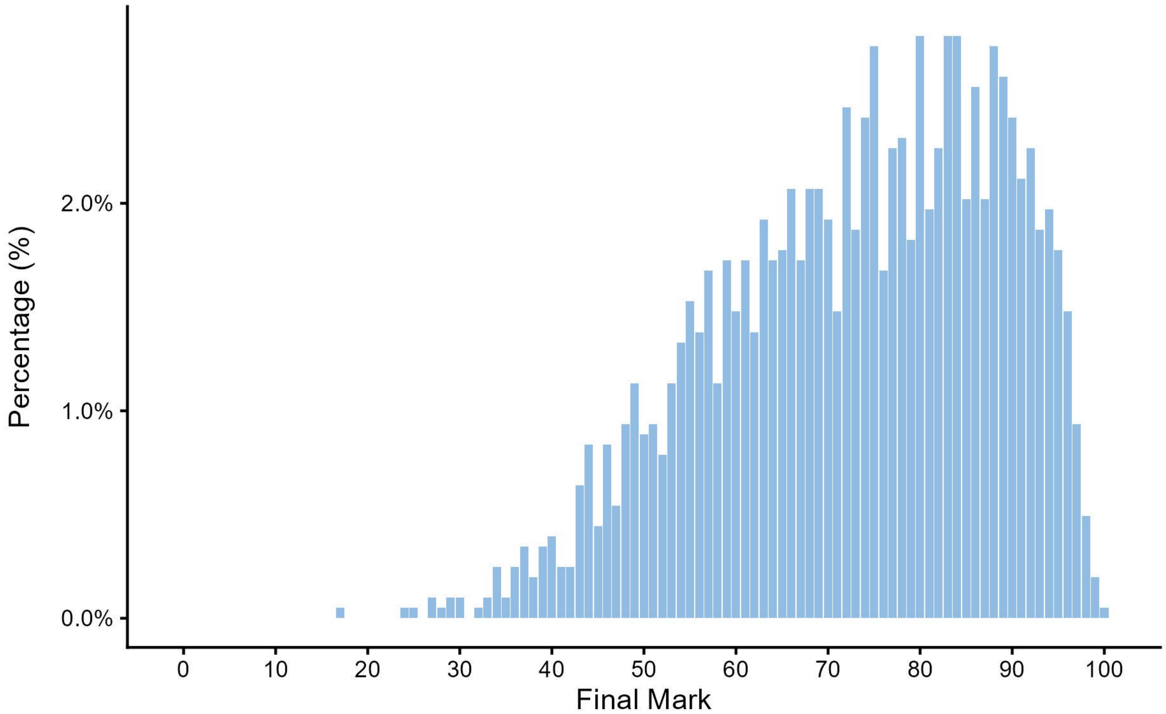


External assessment (EA) marks



Final subject results

Final marks for IA and EA



Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

Standard	A	B	C	D	E
Marks achieved	100–83	82–67	66–46	45–19	18–0

Distribution of standards

Number of students who achieved each standard across the state.

Standard	A	B	C	D	E
Number of students	673	688	569	99	1
Percentage of students	33.15	33.89	28.03	4.88	0.05

Internal assessment

This information and advice relate to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment, and each priority can be further broken down into assessment practices.

Data presented in the Assessment design section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessment. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to *QCE and QCIA policy and procedures handbook v7.0*, Section 9.5.

Percentage of instruments endorsed in Application 1

Internal assessment	IA1	IA2	IA3
Number of instruments	108	108	107
Percentage endorsed in Application 1	25	30	23

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the instrument-specific marking guide (ISMG) and are used to make decisions about the cohort's results.

Refer to *QCE and QCIA policy and procedures handbook v7.0*, Section 9.6.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

Number of samples reviewed and percentage agreement

IA	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	107	754	1	83.18
2	107	752	0	100.00
3	107	759	0	73.83

Internal assessment 1 (IA1)

Project — folio (25%)

This assessment focuses on a problem-solving process that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. The response is a coherent work that documents the iterative process undertaken to develop a solution to a problem. It may include written paragraphs and annotations, diagrams, sketches, drawings, photographs, tables, spreadsheets and prototypes.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions
Alignment	47
Authentication	1
Authenticity	4
Item construction	9
Scope and scale	25

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided an opportunity for students to produce a unique response by omitting images of potential solutions
- included an authentic real-world context that allowed students to explore relevant engineering technology knowledge in relation to the social, ethical, environmental and sustainability impacts of their proposed engineered solution.

Practices to strengthen

It is recommended that assessment instruments:

- include the assessment specifications unaltered, so students can demonstrate evidence of all characteristics of the performance-level descriptors in the ISMG
- provide an opportunity for students to demonstrate their knowledge of Unit 3 subject matter in relation to truss structures

- include an appropriate scale for the prototype solution to ensure valid performance data about the feasibility of the real-world-related solution can be obtained. When including a virtual prototype, use a 1:1 scale.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions
Bias avoidance	1
Language	46
Layout	0
Transparency	0

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- were clearly laid out and legible, using clear and unambiguous language
- provided clear instructions directing students to use the problem-solving process in Engineering to develop a solution to the problem
- instructed students on the appropriate structure for the response and referencing conventions.

Practices to strengthen

It is recommended that assessment instruments:

- avoid language that is not consistent with the Engineering syllabus, e.g.
  - technical jargon or inappropriate language that is not within the scope of the syllabus
  - Design syllabus language that might lead students to explore concepts and principles outside the scope of the syllabus, such as cultural or aesthetic features.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- The structure and the format of the IA1: Engineered solution is different in the 2025 syllabus. Ensure that the specifications are copied unaltered from the syllabus.
- The language of the syllabus changes from Project — folio to Engineered solution, so make sure that the language from the 2019 syllabus is not carried forward into the 2025 IA1.
- Objectives 1 and 3 are not assessed in IA1 in the 2025 syllabus, so students are not required to document the explore phase.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Retrieving and comprehending	98.13	1.87	0.00	0.00
2	Analysing	88.79	11.21	0.00	0.00
3	Synthesising and evaluating	87.85	11.21	0.93	0.00
4	Communicating	96.26	3.74	0.00	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- for the Retrieving and comprehending criterion, evidence supported teacher judgment about symbolisation and explanation of ideas and a solution using graphs, tables, drawings and sketches
- for the Communicating criterion, thoughtful decision-making was evident through the selection of features included in the folio to communicate a solution.

Practices to strengthen

When making judgments for this IA for the 2025 syllabus, it is essential to consider the following key differences between the ISMGs in the 2019 and 2025 syllabuses:

- The number of ISMG criteria have changed from 4 to 3: Symbolising and Communicating (7 marks), Determining and Generating (9 marks), and Synthesising and Evaluating (9 marks).
- The Symbolising and Communicating criterion requires students to use symbolisation in annotated sketches and diagrams to explain their ideas succinctly. For Communicating, students will be assessed on the appropriateness of the visual and written forms of communication selected, as well as their language and grammatical choices and referencing use.
- In the Determining and Generating criterion, for Determining, students will be assessed on how well they have considered the information from the explore phase (prior to assessment) to ascertain which needs, constraints or requirements will be most essential to consider when developing ideas and a solution. For Generating, students will be assessed on
  - the quality of the production of their prototype and how useful it is in producing valid performance data when tested
  - how well they have used the performance data from the prototype testing to decide if elements of the solution are capable of being realised, including comparing the data to the measurable attributes of the success criteria.

- In the Synthesising and Evaluating criterion, for Synthesising, students will be assessed on how well they combine elements of their ideas, and the information obtained from the analysis (prior to the assessment) to develop a solution. For Evaluating, the students will be assessed on
  - how well they have used the success criteria to weigh up the strengths, limitations and implications of their ideas and the solution.
  - how well they have evaluated the data from the prototype testing to make refinements to the solution and use this to justify their recommendations.

To further ensure reliable judgments are made using the ISMG for this IA, it is recommended that:

- when matching evidence to the characteristics in the Synthesising and Evaluating criterion at the upper performance level, attention should be given to using the success criteria to judge the merit or worth of the real-world solution. Enhancements that could be made to the solution as a result of the evaluation are recommended in the student response and are supported by the result of testing the prototype and research.

Additional advice

Schools should:

- guide students to determine success criteria from the analysis of the problem. These should extend beyond the parameters stated in the assessment instrument. Success criteria that include measurable attributes in relation to loading and dimensions can then be used to assess the success of the proposed real-world solution
- encourage students to use symbolisation with annotated sketches and diagrams to synthesise information succinctly. Annotations on sketches and diagrams should be targeted and brief to ensure the Engineered solution is within the word limit
- focus on Unit 3 content for engineering mechanics. Calculations conducted on content outside Unit 3 may hinder students' ability to adhere to the task-length specifications in the 2025 syllabus
- note that justified enhancement recommendations to the real-world solution are required in the 2025 syllabus
- remind students that the written and visual response (including images, graphs, calculations and diagrams) in the 2025 syllabus, is up to 10 A4 pages, up to 2,000 words.

Samples

The following excerpt has been included to provide evidence of adept symbolisation and discerning explanation of a solution in relation to structures with drawings to produce a prototype truss cantilever solution. The engineering drawing includes a title block and parts list for construction of a physical prototype. The parts list demonstrates synthesis of engineering knowledge to determine the materials required to produce the prototype.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.

[redacted]

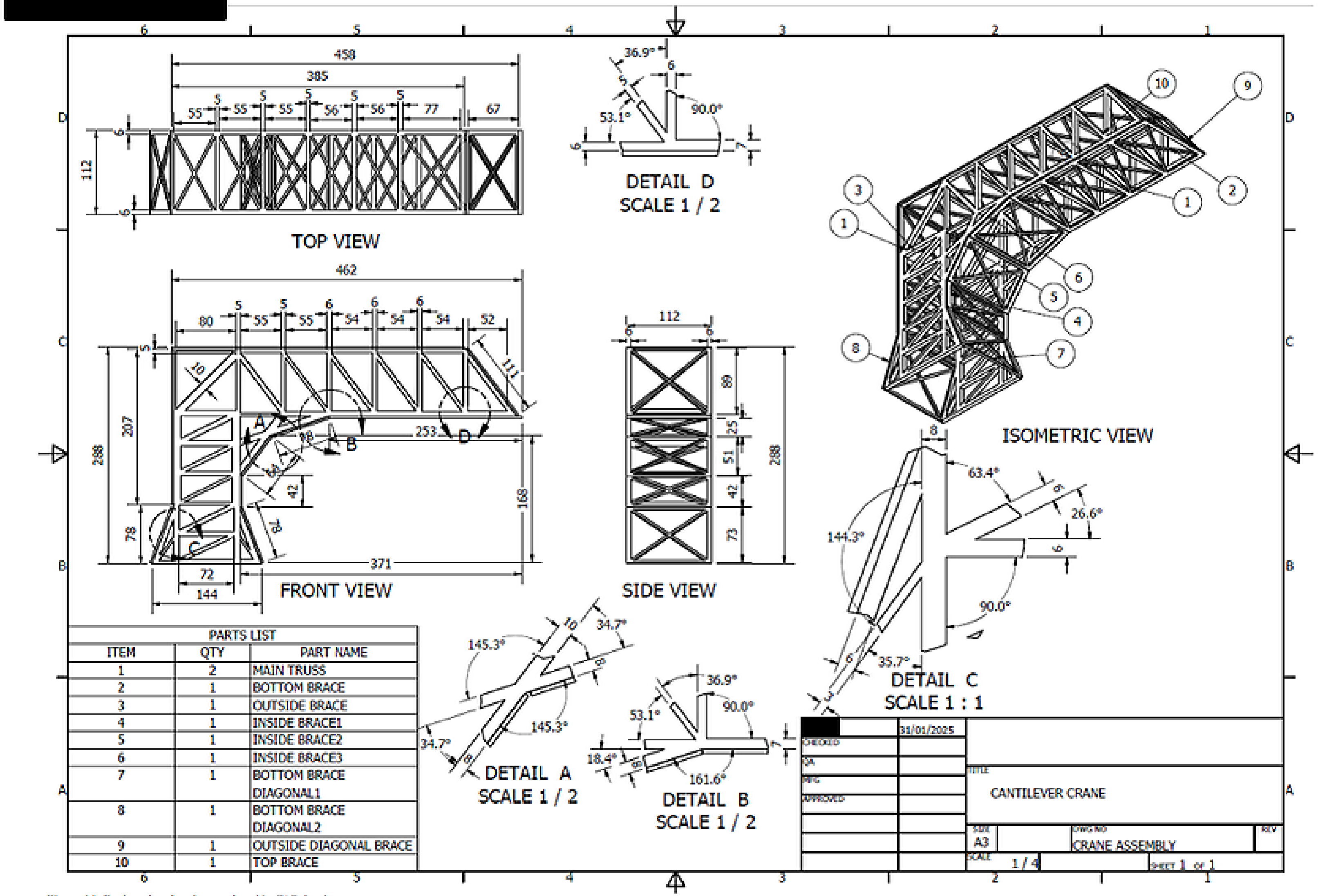


Figure 14: Engineering drawing produced in CAD for the prototype.

The following excerpt has been included to provide evidence of adept symbolisation and discerning explanation of a solution in relation to structures using a diagram or graph to illustrate varying beam thicknesses due to theoretical variations of forces in members. It also demonstrates coherent and logical synthesis of ideas and relevant engineering mechanics to reduce material usage where appropriate.

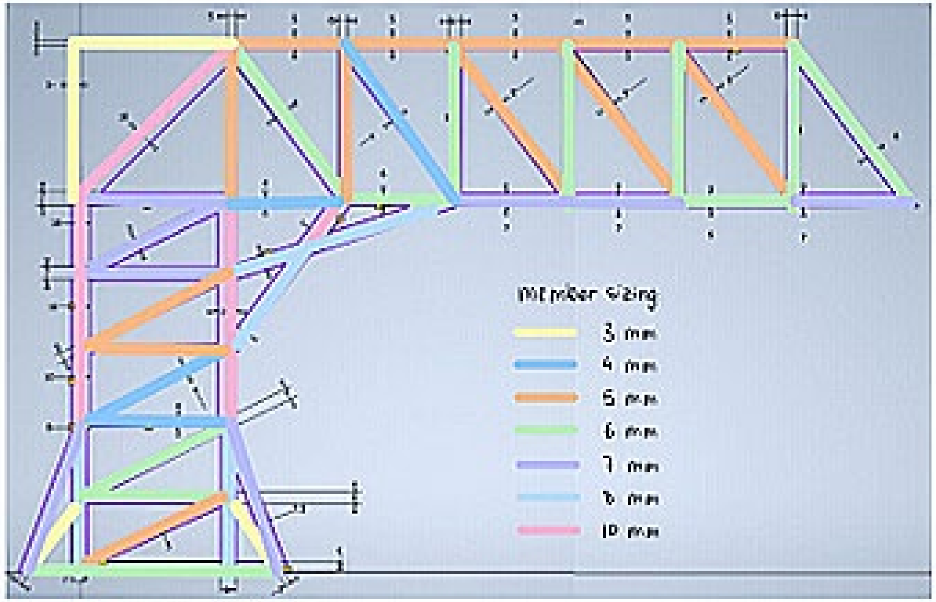


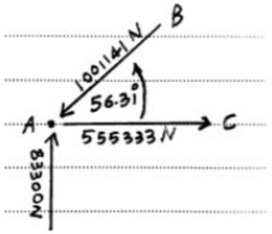
Figure 13: Prototype member sizing.

The following excerpt has been included as it shows coherent and logical synthesis of engineering mechanics and technology to propose appropriate beam sizes for each member in the real-world solution to a structural truss bridge problem. For the 2025 syllabus, when determining word length, the text box that contains the formula for stress, does not constitute processed data, and as such the text in the box would be counted in the word length.

Determine the appropriate members for the design

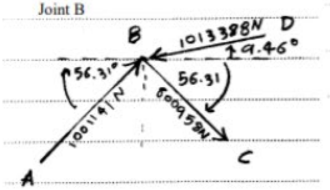
Identifying the force on each member of the truss using the method of joints

Joint A



$\sum F_x = 0 = F_{AB}\cos(56.31) + F_{AC}$
$\sum F_y = 0 = 833000 + F_{AB}\sin(56.31)$
$F_{AB} = -\frac{833000}{\sin(56.31)} \approx -1001141\ N\ (C)$
$\therefore F_{AC} = F_{AB}\cos(56.31)$
$\approx 555333\ N\ (T)$

Joint B

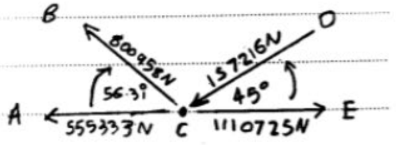


$\sum F_x = 0 = -F_{BD}\cos(9.46) - F_{BC}\cos(56.31) + 1001141\cos(56.31)$
$\sum F_y = 0 = -F_{BD}\sin(9.46) + F_{BC}\sin(56.31) + 1001141\sin(56.31)$
$F_{BD} = \frac{-F_{BC}\sin(56.31) - 1001141\sin(56.31)}{\sin(9.46)}$

Solving through substitution

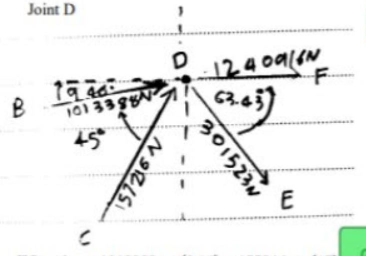
$0 = -\frac{-F_{BC}\sin(56.31) - 1001141\sin(56.31)}{\sin(9.46)}\cos(9.46) - F_{BC}\cos(56.31) + 1001141\cos(56.31)$
$F_{BC} = 800958\ \text{N (T)}$
$F_{BD} = \frac{-800958\ \sin(56.31) - 1001141\sin(56.31)}{\sin(9.46)}$
$F_{BD} = -1013405N\ (C)$

Joint C



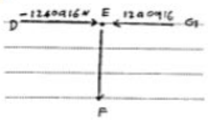
$\sum F_x = 0 = F_{CD}\cos(45) + F_{CE} - 555333 - 800958\cos(56.31)$
$\sum F_y = 0 = F_{CD}\sin(45) + 800958\sin(56.31) - 555333$
$F_{cd} = \frac{-800958\sin(56.31) + 555333}{\sin(45)} \approx -156216N\ (C)$
$F_{CE} = 156216\cos(45) + 555333 + 800958\cos(56.31)$
$\approx 1110725\ N\ (T)$

Joint D



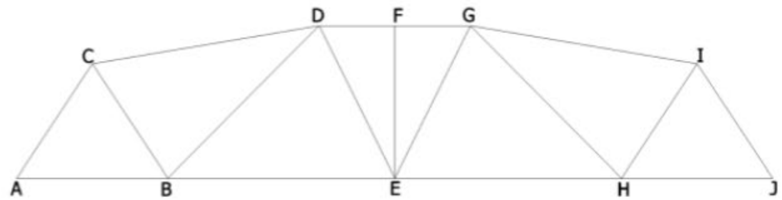
$\sum F_x = 0 = -1013388\cos(9.46) + 157216\cos(45) + F_{DE}\cos(64.43) + F_{DF}$
$\sum F_y = 0 = 1013388\sin(9.46) + 157216\sin(45) - F_{DE}\sin(64.43)$
$F_{DE} = \frac{1013388\sin(9.46) + 157216\sin(45)}{\sin(64.43)} \approx 301523\ N\ (T)$
$F_{DF} = -1013388\cos(9.46) + 157216\cos(45) + 301523\cos(64.43)$
$\approx -1240916\ N\ (C)$

Joint E



$\sum F_x = 0 = 1240916 + F_{EG}$
$F_{EG} = -1240916N\ (C)$
$\sum F_y = 0 = F_{EF}$
$\therefore$ *Member EF is a redundent member.*

Since the bridge is symmetrical the members have equal stress on the other joints



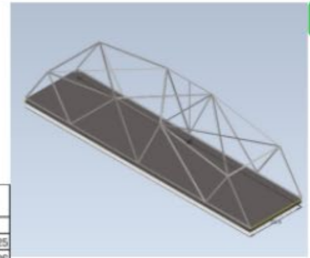
MEMBER	FORCE	AREA REQUIRED (cm^2)	BEAM (UC)
AC	1001141.40	40.05	UC 152 x 152 x37
AB	555333.33	22.21	UC 152 x 152 x23
CB	800913.12	32.04	UC 152 x 152 x23
BE	1110666.66	44.43	UC 152 x 152 x37
HC	800913.12	32.04	UC 152 x 152 x23
CJ	1001141.40	40.05	UC 152 x 152 x37
HJ	555333.33	22.21	UC 152 x 152 x23
EH	1110666.66	44.43	UC 152 x 152 x37
CD	1013388.23	40.54	UC 152 x 152 x37
ED	310440.77	12.42	UC 152 x 152 x23
HG	157071.99	6.28	UC 152 x 152 x23
EG	310440.77	12.42	UC 152 x 152 x23
BD	157071.99	6.28	UC 152 x 152 x23
CD	1013388.23	40.54	UC 152 x 152 x37
DF	1,249,499.99	49.98	UC 203 x 203 x46
GF	1249499.99	49.98	UC 203 x 203 x46
EF	0.00	0.00	UC 152 x 152 x30

The beam size can be calculated by identifying the force in each member and then using the stress equation to identify the required cross-sectional area afterwards using the dimensions of universal beams an appropriate beam can be identified.

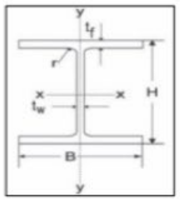
Rearranging the stress equation for area

$$\sigma = \frac{F}{A} \qquad A = \frac{F}{\sigma}$$

Where σ is the tensile strength of the material (250Mpa)
F is the force in the member
And A is area



Description Beams	Sectional Weight	Total Depth	Flange Width	Thickness of Web	Thickness of Flange	Root radius	Area of Section
	w (Kg/m)	H mm	B mm	tw mm	tr mm	r mm	A cm^2
UC 152 x 152 x23	23	152.4	152.2	5.8	6.8	7.6	29.25
UC 152 x 152 x30	30	157.6	152.9	6.5	9.4	7.6	38.26
UC 152 x 152 x37	37	161.8	154.4	8	11.5	7.6	47.11
UC 203 x 203 x46	46.1	203.2	203.6	7.2	11	10.2	58.73



Internal assessment 2 (IA2)

Examination (25%)

The examination assesses the application of a range of cognitions to multiple provided items — questions, scenarios and problems.

Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions
Alignment	86
Authentication	0
Authenticity	21
Item construction	9
Scope and scale	4

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided sufficient information within written and/or visual stimulus for students to respond appropriately within the time allocated to the item.

Practices to strengthen

It is recommended that assessment instruments:

- align with the question specifications in relation to the degree of difficulty required for simple familiar, complex familiar and complex unfamiliar questions
- include complex unfamiliar items that are sufficiently different to the complex unfamiliar items in the QCAA sample instrument to ensure that students have had limited prior experience in the context and information provided to solve the problem.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions
Bias avoidance	5
Language	6
Layout	5
Transparency	4

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- provided clear instructions that were aligned to the assessment specifications and objectives
- included diagrams and other visual elements that were legible, clear and relevant.

Practices to strengthen

It is recommended that assessment instruments:

- avoid the use of unnecessary jargon or overly technical language that is not syllabus terminology, e.g. homogenous.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- Subject matter has been moved between units to ensure better alignment and progression across the two years of study.
- The IA2 instrument must only assess students' knowledge of Unit 3 subject matter.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Engineering knowledge and problem-solving	100.00	0.00	0.00	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- marking schemes that clearly identified the allocation of marks for each question included matching individual marks in a question to wanted values or attributes in the response

- the evidence presented in student responses to short-paragraph questions used key terms and ideas that were specifically identified in the marking scheme
- in calculation questions, the marking scheme stated where follow-through errors were permitted and when this occurred in responses, it was clearly identified.

Practices to strengthen

There were no significant issues identified for improvement.

Additional advice

Schools should:

- upload an amended marking scheme for confirmation if required. The amended marking scheme must support the endorsed task and confirmation process and clearly indicate the mark awarded to the questions
- for calculation questions, ensure the individual marks allocated on the marking scheme match the total marks for the question. Marks allocated to student responses for calculations undertaken should align to the marking scheme, e.g. where the marking scheme for a truss question does not allocate marks to calculating the angle of the truss, marks should not be awarded for this calculation. Only award marks where marks are allocated.

Samples

The following excerpt has been included to provide evidence of a well-structured response to a short response question that required analysing the social and sustainability factors of an historic construction material and its modern replacement. Marks are clearly displayed on the written response and the total mark for the question is included with the response.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.

(6 marks)

A historical construction material is ordinary timber. It's contemporary replacement is engineered timber.

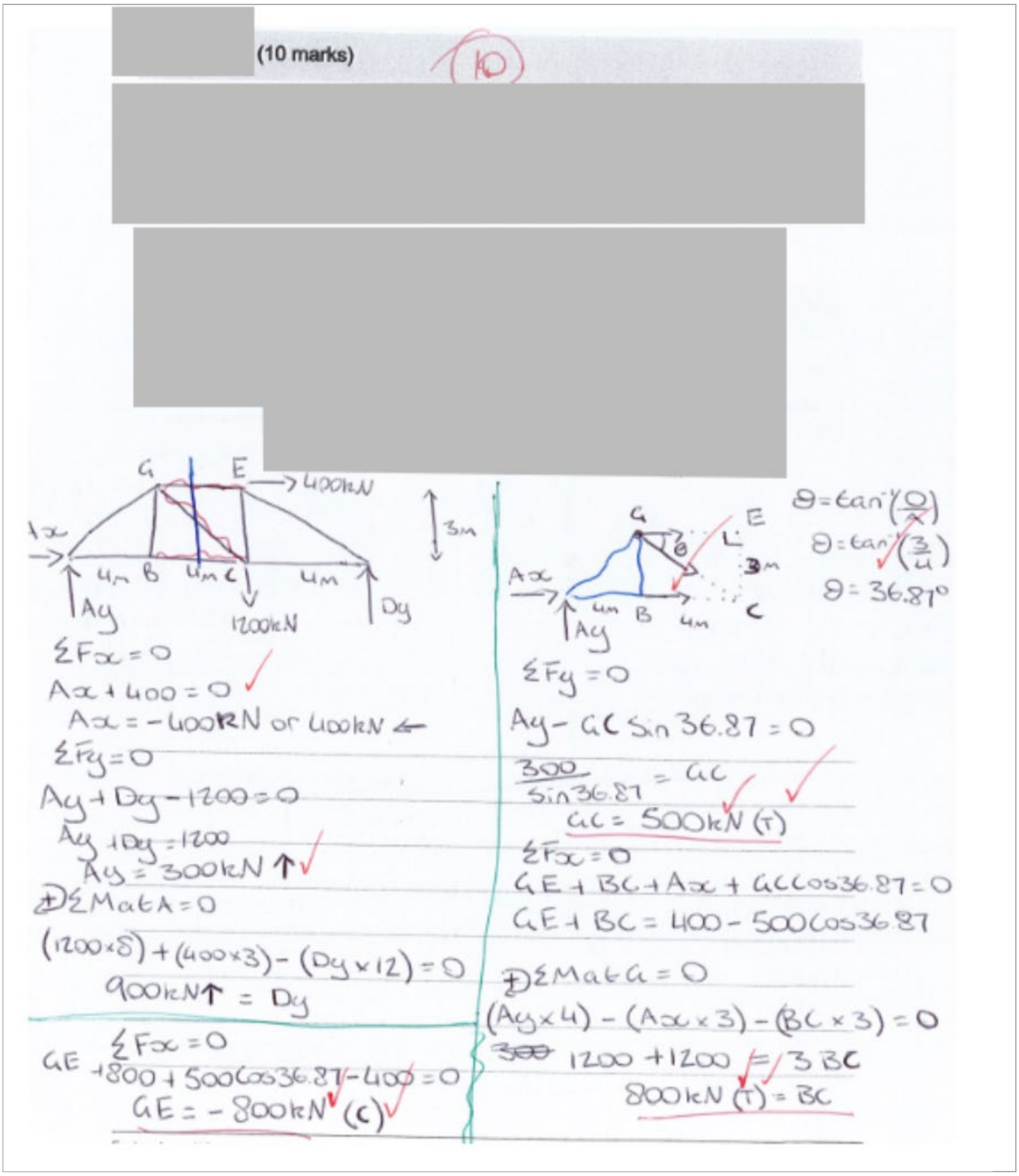
Social

- It has a higher strength to mass ratio requiring less material to support the same weight providing more space for the community.
- It has multidirectional strength as grains aren't parallel increasing safety.

Sustainable

- It can use more of the wood which would of traditionally been wasted.
- It is not recyclable but ~~it is~~ both are biodegradable.

The following excerpt has been included to provide evidence of a well-structured response to a question that required calculating the forces in specified members using method of sections. A force diagram was required in the response, and a mark was allocated to the force diagram in the marking scheme. Marks are clearly annotated and the total mark for the question is included.


(10 marks)
10
G
E
400kN
3m
Ax
4m
B
4m
C
4m
Ay
1200kN
Dy
ΣFx = 0
Ax + 400 = 0
Ax = −400kN or 400kN ←
ΣFy = 0
Ay + Dy − 1200 = 0
Ay + Dy = 1200
Ay = 300kN ↑
ΣM at A = 0
(1200×8) + (400×3) − (Dy×12) = 0
900kN↑ = Dy
ΣFx = 0
GE + 800 + 500cos36.87 − 400 = 0
GE = −800kN (C)
θ = tan⁻¹(O/A)
θ = tan⁻¹(3/4)
θ = 36.87°
ΣFy = 0
Ay − GC sin 36.87 = 0
300 / sin36.87 = GC
GC = 500kN (T)
ΣFx = 0
GE + BC + Ax + GC cos36.87 = 0
GE + BC = 400 − 500cos36.87
ΣM at G = 0
(Ay×4) − (Ax×3) − (BC×3) = 0
1200 + 1200 = 3BC
800kN (T) = BC

Internal assessment 3 (IA3)

Project — folio (25%)

This assessment focuses on a problem-solving process that requires the application of a range of cognitive, technical and creative skills and theoretical understandings. The response is a coherent work that documents the iterative process undertaken to develop a prototype solution to a problem, situation or need. It includes written paragraphs and annotations, diagrams, sketches, drawings, photographs, tables, spreadsheets and prototypes.

This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions
Alignment	45
Authentication	1
Authenticity	0
Item construction	7
Scope and scale	53

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided an authentic, real-world-related context about a machines and/or mechanisms problem that allowed students to demonstrate their understanding of simple machines, mechanisms and logic control technology.

Practices to strengthen

It is recommended that assessment instruments:

- contain all the information from the assessment specifications without alteration to ensure that students can demonstrate all the required characteristics to match evidence to the ISMG
- include a suitable scale for prototype solutions that allow students to obtain valid performance data to support the determination of the feasibility of the real-world solution. When including a virtual prototype, use a 1:1 scale.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions
Bias avoidance	1
Language	38
Layout	0
Transparency	0

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- included a context and layout that is clearly organised and provides clear instructions for students to respond appropriately to the task.

Practices to strengthen

It is recommended that assessment instruments:

- avoid the use of language that is not in the Engineering syllabus. Design syllabus language, such as ‘design’ or ‘folio’ is not appropriate and can lead students to explore subject matter that is not in the scope of the syllabus.

Additional advice

When developing an assessment instrument for this IA, it is essential to consider the following key differences between the 2019 and 2025 syllabuses:

- The structure and the format of the IA3: Engineered solution is different in the 2025 syllabus. Ensure that the specifications are copied unaltered from the syllabus.
- The language of the syllabus changes from Project — folio to Engineered solution, so make sure that the language from the 2019 syllabus is not carried forward into the 2025 IA3.
- Objectives 1 and 3 are not assessed in IA3 in the 2025 syllabus, therefore students are not required to document the explore phase.

Assessment decisions

Reliability

Reliability refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Retrieving and comprehending	93.46	5.61	0.93	0.00
2	Analysing	84.11	15.89	0.00	0.00
3	Synthesising and evaluating	86.92	13.08	0.00	0.00
4	Communicating	98.13	0.93	0.93	0.00

Effective practices

Reliable judgments were made using the ISMG for this IA when:

- for the Synthesising and Evaluating criterion, evidence supported teacher judgments
  - about coherent and logical synthesis of Unit 4 engineering knowledge, including mechanics, material science, technology and control technologies
  - when the student response demonstrated complete prototype generation, either physical or virtual, of the real-world solution
  - about valid performance data when the response included prototype testing that enabled measurable data to be analysed and used to critically assess the real-world solution.

Practices to strengthen

When making judgments for this IA for the 2025 syllabus, it is essential to consider the following key differences between the ISMGs in the 2019 and 2025 syllabuses:

- All changes to criterion detailed in IA1 Assessment decisions apply to IA3. **Note**: Synthesising includes control technologies.

To further ensure reliable judgments are made using the ISMG for this IA, it is recommended that:

- schools use the correct ISMG when making judgments about the response (*QCE and QCIA policy and procedures handbook v7.0*, Sections 7.3.3 and 8.3). The ISMG assesses the objectives using Unit 4 subject matter
- for astute determination of essential success criteria, student responses must go beyond statements made in the task context and specifications.

Additional advice

Schools should:

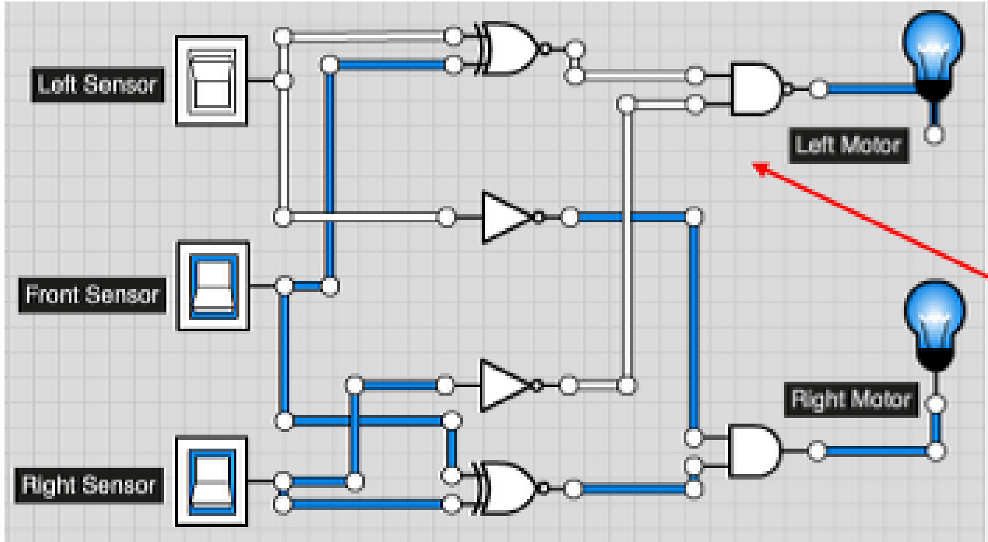
- note logic control technology must be included in the engineered solution to the real-world-related problem
- note justified enhancement recommendations to the real-world solution is required in the 2025 syllabus
- ensure that the marks indicated in the IMSG are transcribed correctly into student management when submitting provisional marks.

Samples

The following excerpt has been included to provide evidence of coherent and logical synthesis of relevant control technologies via a logic gate system used to control an autonomous road sweeper. Also, the excerpt demonstrates adept symbolisation using diagrams with annotations, which are effective for the Symbolising and Communicating criterion and response length in the 2025 syllabus.

Note: The characteristic/s identified may not be the only time the characteristic/s occurred throughout a response.

Moving Left and Right using the Different Sensors



When both the front and left sensors detect an obstacle (input = 1), the system processes this through logic gates to determine the correct response—such as executing a right turn to avoid a collision. If no obstacles are detected (inputs = 0), the output will direct the motors to continue moving forward.

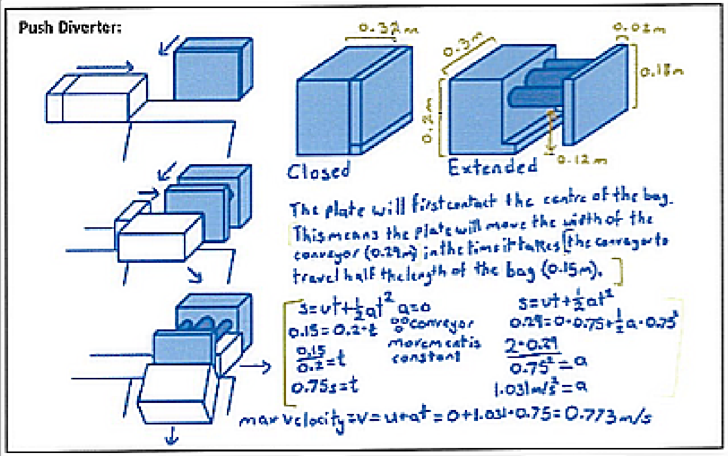
Input			Output	
A	B	C	A	B
1	1	1	0	0
0	0	0	0	0
1	1	0	0	1
0	1	1	1	0

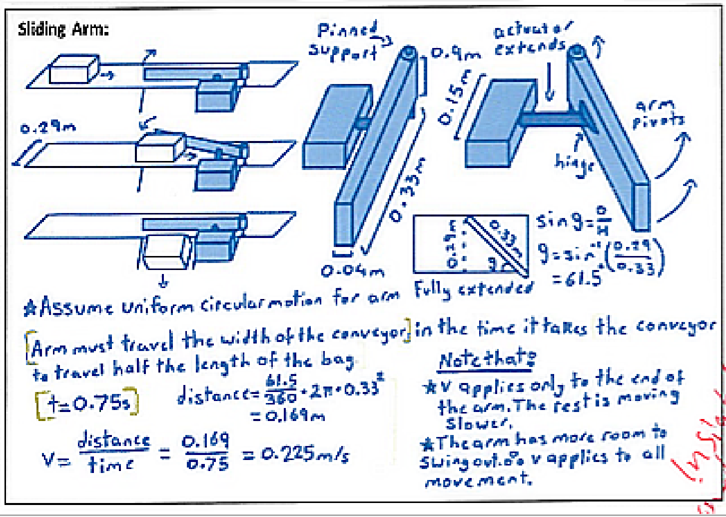
Decisions can be represented through truth tables, which show how different binary input combinations (0 = no detection, 1 = detection) result in specific outputs (e.g. stop, turn, or move forward).

Truth tables provide a visual and logical structure that helps plan the vehicle's programmed responses to its environment (C10), enabling clear mapping of input-output combinations and enhancing the reliability of the prototype's decision-making logic.

The following excerpt has been included to provide evidence of coherent and logical synthesis of relevant engineering mechanics, materials science and technology knowledge used to manage the movement of 10 kg and 20 kg cement bags along a conveyor in a cement packing and distribution facility. Also, the excerpt demonstrates adept symbolisation using diagrams with calculations and annotations, which are effective for the Symbolising and Communicating criterion and response length in the 2025 syllabus.

Excerpt 1





Chosen Solution

The push diverter has been chosen for implementation. It will have curved edges on the plate to prevent rupturing of cement bags, and it will be welded to the side of the conveyor ensuring it has a secure attachment, preventing movement of the system ensuring efficient and predictable movements that can be recalibrated. The maintenance for this technology is simpler than a pushing arm, it can be taken apart to access the interior where the motor and actuators are located, with the cover preventing major damage which will lower cost and frequency of required maintenance. Another benefit of this technology is the linear movement. While the decline for the 10kg bags should still be wider than the 20kg decline (approximately 0.4m), there is less chance of the bag colliding and rupturing against a wall with only the regular safety rails required.

Given that the push diverter has been chosen, stainless steel will be used to construct it. This material has a relatively high density; however, this should not limit the technologies potential as it will be hollow. The major benefits of the materials strength and friction will be unaffected and allow efficient sorting.

External assessment

External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day. The external assessment papers and the external assessment marking guide (EAMG) are published in the year after they are administered.

Examination (25%)

Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus.
The examination consisted of one paper including questions derived from the context of Unit 4 subject matter (77 marks).

The paper required students to respond to multiple choice and short response questions:

- Section 1 consisted of multiple choice questions (10 marks)
- Section 2 consisted of short response questions (34 marks)
- Section 3 consisted of short response calculation questions (33 marks).

Assessment decisions

Assessment decisions are made by markers by matching student responses to the EAMG.

Multiple choice question responses

There were 10 multiple choice questions.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	5.33	**73.54**	6.33	14.55
2	12.01	**71.00**	7.42	9.17
3	18.78	13.30	27.70	**39.46**
4	2.24	1.69	10.21	**85.60**
5	6.63	5.98	**79.72**	7.42
6	9.87	3.79	**82.81**	3.09
7	**65.82**	6.08	2.84	25.01
8	**79.22**	7.67	7.62	4.83
9	**71.60**	14.90	3.24	9.87
10	2.89	**77.53**	13.30	5.68

Effective practices

Overall, students responded well when they:

- produced succinct and complete responses to simple familiar, complex familiar and complex unfamiliar short response questions using relevant information that clearly demonstrated knowledge of the required Unit 4 subject matter
- developed responses to simple familiar calculation questions that required them to determine the mechanical advantage and the load force from the given efficiency, velocity ratio, and effort force
- produced responses to simple familiar and complex familiar calculation questions that required knowledge of work, power, kinetic energy, equations of motion and inclined planes.

Practices to strengthen

When preparing students for external assessment, it is recommended that teachers:

- provide students with strategies that assist with understanding the included requirements of questions. Underlining key points, noting the cognitions and the number of marks are strategies that students may use as they analyse questions in preparation for providing complete and appropriate responses
- consider developing students' ability to explain the difference between static and kinetic friction and to clearly label force vectors, including arrows in free-body diagrams to correctly illustrate the application of these and other forces
- assist students with interpretation of specific conditions to create logic gate circuits that include clearly annotated inputs and outputs, e.g. on and off conditions for a range of familiar and unfamiliar contexts that align with provided truth tables
- support students to include in their responses to calculation questions, explicit statements that fully explain the working used to develop solutions, e.g. MA=VR when 100% efficient.

Additional advice

Schools should:

- ensure students understand that when performing a multi-step calculation, they should leave rounding until the end of the calculation to reduce the risk of answers being out of the acceptable tolerance range. Additionally, schools should ensure students understand that they should not round answers to the nearest whole unit when not directed to do so and must round answers correctly, e.g. 0.776 should be rounded to 0.78, not 0.77
- be aware that the assessment conditions provide for perusal time prior to 120 minutes of working time and ensure students understand how to use perusal time wisely and strategically to familiarise themselves with the paper's questions and structure.

Samples

Short response

Question 11

This question required students to label the indicated phases present at 100 °C given the microstructures for lead-tin alloys at 10% and 40% tin.

Effective student responses:

- addressed the question by labelling the phases of a lead–tin alloy and not that of carbon steel
- indicated the phases correctly as alpha and beta.

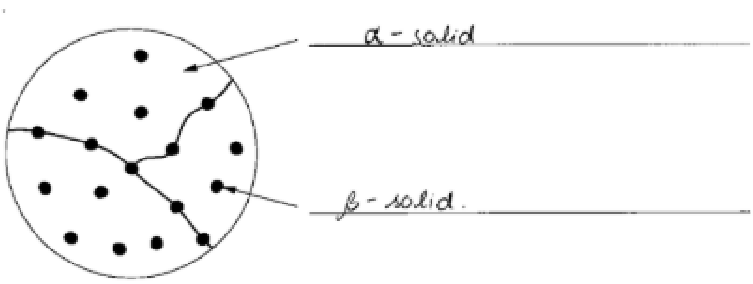
These excerpts have been included:

- to demonstrate the evidence required of a high-level response, including
  - Part A microstructures correctly labelled
  - Part B microstructures correctly labelled.

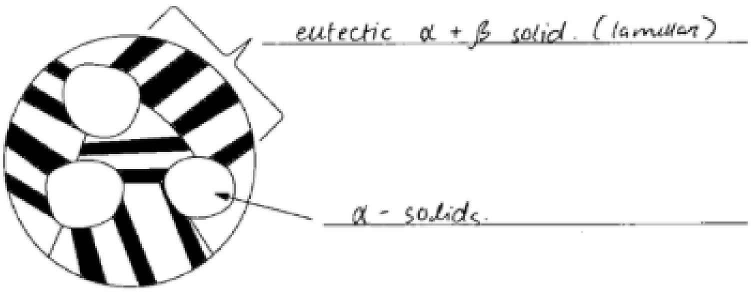
Excerpt 1

Label the phases present at 100 °C in the microstructures of the lead–tin alloys shown.

a) 10% tin alloy *[2 marks]*

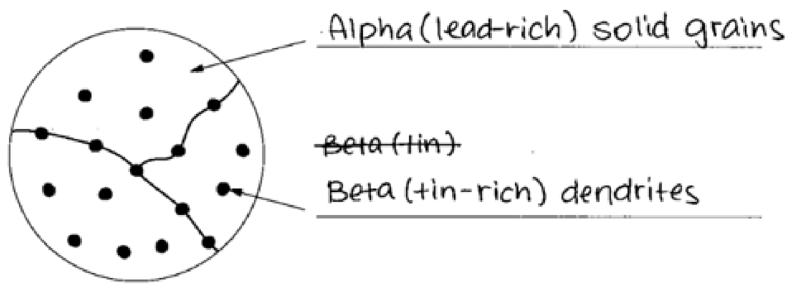


b) 40% tin alloy *[2 marks]*

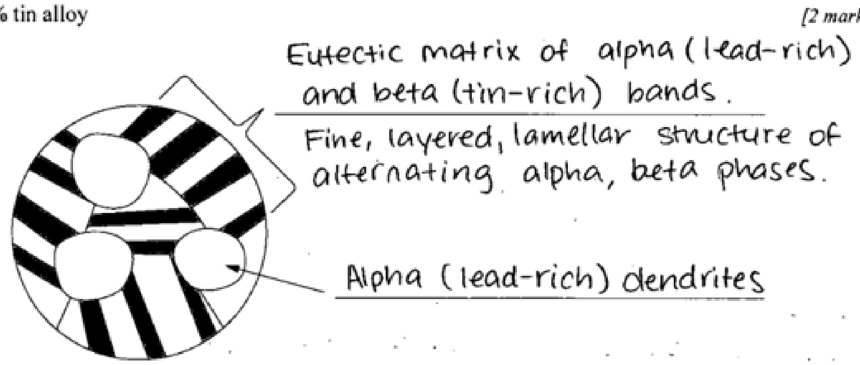


Excerpt 2

a) 10% tin alloy *[2 marks]*



b) 40% tin alloy *[2 marks]*



Question 13

This question required students to describe static friction and kinetic friction in terms of the angle of repose using a force diagram to support each description.

Effective student responses:

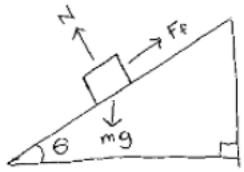
- provided a correctly labelled force diagram to support the description for both static and kinetic friction
- included the angle of repose and the angle of incline to correctly describe static and kinetic friction with reference to the force diagram.

These excerpts have been included:

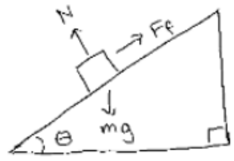
- to demonstrate the evidence required of a high-level response, including
  - correctly producing and labelling force diagrams for both static and kinetic friction
  - accurately describing static and kinetic friction with reference to the angle of repose, the angle of the incline and the force diagrams.

Excerpt 1

Static friction



Kinetic friction



Note: If you make a mistake, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this book.

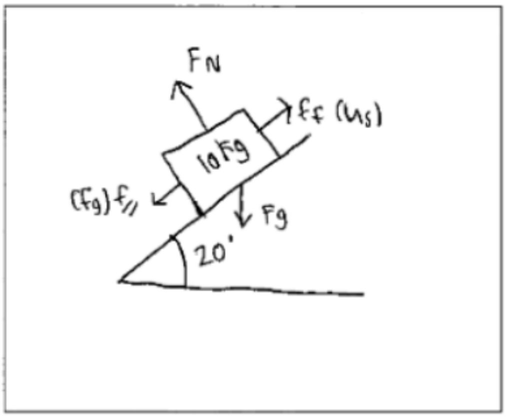
Friction is the force that opposes motion. The angle of repose (θ) is the angle ~~Static friction is the force that opposes motion when the object is stationary~~ at which an object on an incline is about to change from static to kinetic (ie. start moving). Static friction is the product of the coefficient of static friction (μ_s) and the normal force, and it is the force that opposes motion for a stationary object. When $\mu_s \geq \tan\theta$, the object will remain stationary as the component of weight force down the incline is insufficient to overcome the static friction. When $\mu_s < \tan\theta$, the weight force down the incline plane is greater than the static friction force so the object will accelerate down the plane.

Kinetic friction is the product of the coefficient of kinetic friction (μ_k) and the normal force, and it is the force that opposes motion for an object in motion.

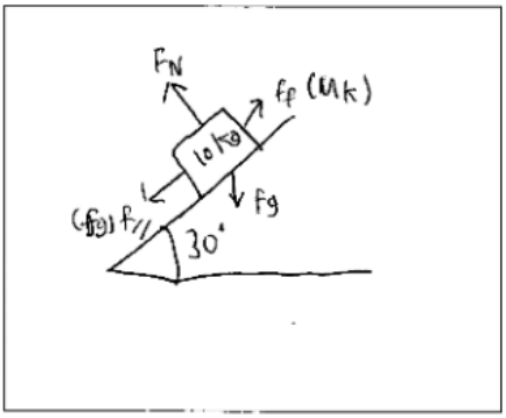
When $\mu_k \leq \tan\theta$, the kinetic friction force is less than or equal to the component of weight force down the incline, so the object will remain in motion. When $\mu_k > \tan\theta$, the kinetic friction force is greater than the weight force down the incline, so a moving object would decelerate and eventually be at rest.

Excerpt 2

Static friction



Kinetic friction



Note: If you make a mistake, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this book.

~~Static friction $\therefore F_f = mg\sin\theta$ frictional force is equal to~~

the static friction for an object is the amount of frictional force they experience when stationary. The angle of repose for static friction is the maximum angle an object can experience on an incline before overcoming the frictional force due to F_g and sliding down, and is given by $\mu_s = \tan\theta$. In the diagram above, assuming the maximum angle is 20°, this gives the coefficient of static friction as $\mu_s = \tan 20 = 0.36$, to find the force, the coefficient can be multiplied by the normal force. The kinetic friction of an object is the frictional force experienced ~~of~~ when the object is in motion. The angle of repose for kinetic friction is the minimum angle an object can experience before coming to a stop, becoming stationary as the frictional force overcomes the gravitational force down the incline. In the diagram (left), ~~assumin~~ assuming the minimum angle is 30°, this gives the coefficient of kinetic friction as $\mu_k = \tan\theta \therefore \mu_k = \tan 30 = 0.58$, to find the frictional force the coefficient can be multiplied by the normal force.

Question 15

This question required students to explain how engineers have used their expertise in materials science, mechanics and control technology to develop a solution to a small business premises access security problem. The response was to include two benefits of the solution for the small business.

Effective student responses:

- identified a valid machine/mechanism solution to the problem
- provided an appropriate explanation that included materials science, mechanics and control technology to develop a solution and two benefits for the small business.

These excerpts have been included:

- to demonstrate the evidence required of a high-level response
- to show a clear and concise explanation with
  - a valid machine/mechanism solution
  - materials science, mechanics and control technology expertise
  - two benefits to the small business.

Excerpt 1

Controlling access to premises is an issue that affects many small businesses. Loss or damage to property from unauthorised access can be very expensive and result in loss of business if premises have to close while damage is repaired. Small businesses need to consider how to make it easy for authorised persons to access their premises while deterring, detecting and protecting from unauthorised access and informing police and business owners.

Identify a machine or mechanism solution to help businesses control authorised and unauthorised access to their premises. Explain how engineers have used their expertise in materials science, mechanics and control technology to develop this solution. Include two benefits of the solution for a small business in your response.

In a strictly authorised-only business area, a camera-assisted ~~card-accessed~~ finger-print-accessed system can be used to allow authorised persons to access premises. Unauthorised entries would be immediately identified, and access would be restricted. The uniqueness of fingerprints also means no ~~rep~~ duplication can occur, as with card or code access, and it is unlikely to be incorrect, or intrusive, unlike facial recognition. Engineers have built such technology using sensors and machine learning, as part of control technology to identify fingerprints and such data to associate with relevant persons, and actuate ~~opening~~ locking/unlocking of doors and sounding alarms. Material science has to be applied in using transparent but sturdy materials to scan the input, and have unbreakable doors, abrasion resistant. ~~They~~ would also need mechanics using gear system ~~of~~ or such to transfer feedback into motion in opening doors/lock system. This benefits businesses by preventing break-ins, logging access automatically and affordably installing technology as it is already available.

Excerpt 2

Engineers have used their expertise to create doors which unlock by scanning a keycard. They have used their knowledge of materials science to select suitable materials for the door as it must be durable, tough and impact resistant, to withstand use and potential attempted break-ins. They have used their knowledge of control technology so that the door will open when a valid keycard is scanned and also sensors so that detect unauthorised access to alert business owners. They have used their knowledge of mechanics for the opening and closing of the door (hinge, sliding doors etc.) and the lock mechanism. This device limits access to only authorised people and businesses can also keep track of the use of premises. It also deters unauthorised access and informs business owers about detection of intruders.

Question 19

This question required students to analyse a lead–tin thermal-equilibrium diagram to identify the percentage of lead in the eutectic composition and determine the percentages of solid and liquid in a 60% lead alloy at 200 °C using the inverse lever rule.

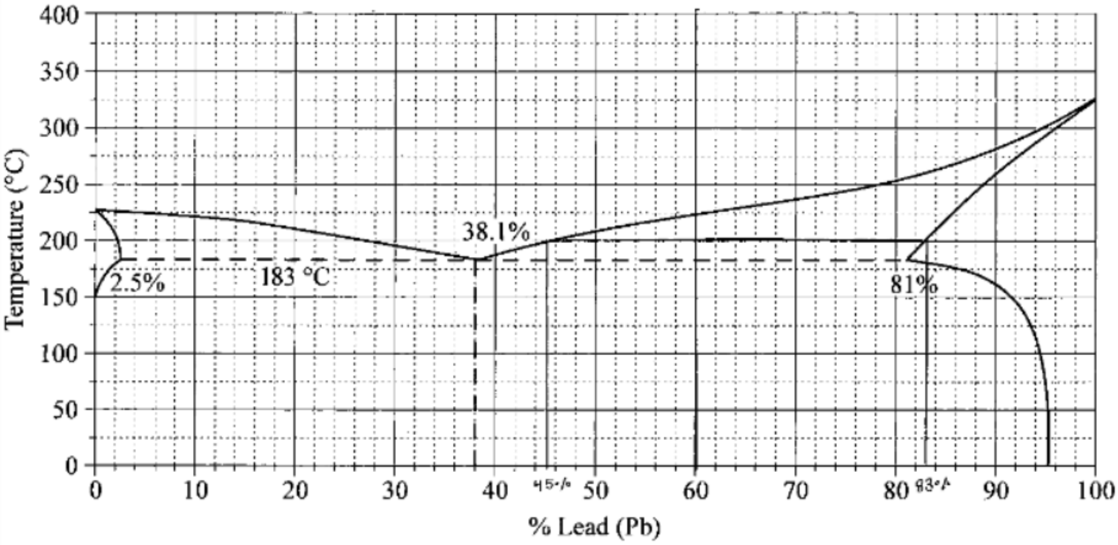
Effective student responses:

- correctly identified the percentage of lead in the eutectic composition from the diagram as 38.1%
- correctly annotated the diagram and accurately calculated the percentage solid and liquid at 200 °C within the accepted range.

These excerpts have been included:

- to demonstrate the evidence required of a high-level response with
  - a clearly annotated diagram
  - a well-structured calculation showing use of the inverse lever rule to determine the solid and liquid composition at 200 °C.

Excerpt 1



a) Identify the percentage of lead in the eutectic composition. *[1 mark]*

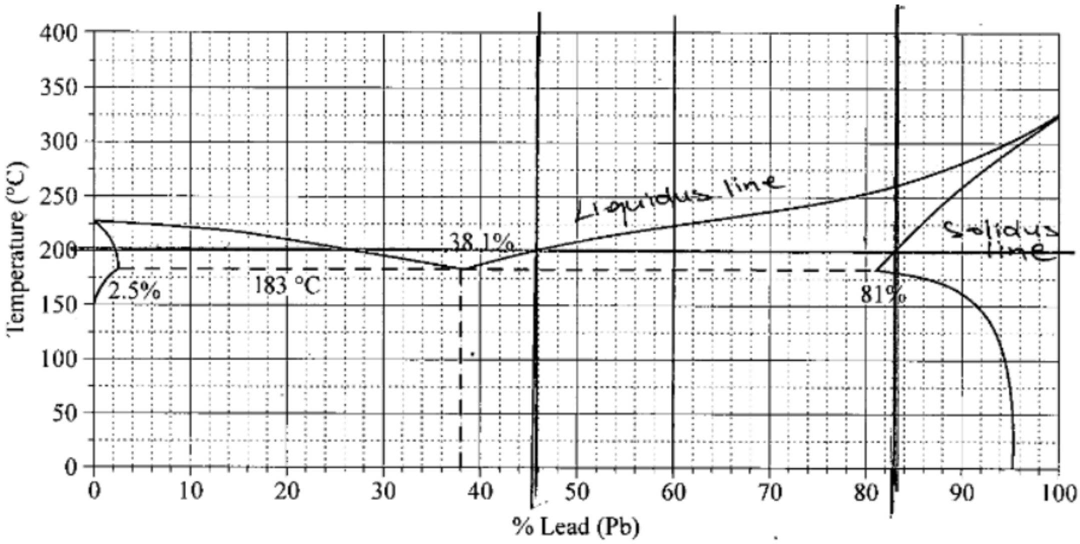
38.1%

b) Determine the percentages of solid and liquid in a 60% lead alloy at 200 °C using the inverse lever rule. Annotate the diagram to support your response.

$\% \text{ solid} = \frac{60-45}{83-45} \times 100\% \approx 39.5\%$ solid

$\% \text{ liquid} = \frac{83-60}{83-45} \times 100\% \approx 60.5\%$ liquid

Excerpt 2



a) Identify the percentage of lead in the eutectic composition. *[1 mark]*

38.1%

b) Determine the percentages of solid and liquid in a 60% lead alloy at 200 °C using the inverse lever rule. Annotate the diagram to support your response. *[3 marks]*

Solid : Liquid	Total parts
22 : 36	= 58
= $\frac{22}{58}$: $\frac{36}{58}$	Solidus Liquidus $\frac{36}{58}$: $\frac{22}{58}$
= 0.3793 : 0.6207	
= 37.93% : 62.07%	
	Solid : Liquid
% Solid = 37.93%	$\frac{22}{58}$: $\frac{36}{58}$
% Liquid = 62.07%	

Question 21

This question required students to construct a labelled logic gate circuit to specifications provided for conveyor belt 2 as part of a system used to transport packages from a factory to a loading bay. A corresponding truth table was to be completed by students as part of the response.

Effective student responses:

- provided a correctly applied logic gate circuit with all inputs and outputs clearly labelled
- included correctly completed truth table columns E and X.

These excerpts have been included:

- to demonstrate the evidence required of a high-level response with
  - a correctly applied logic gate circuit

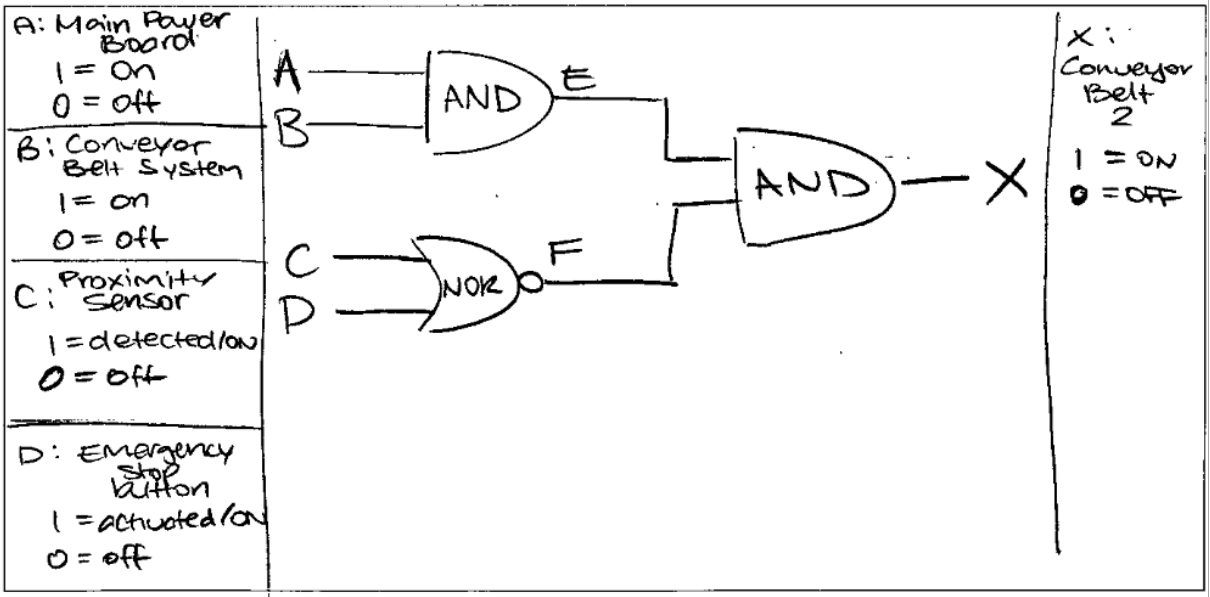
- all inputs and outputs clearly labelled
- a correctly completed truth table.

Excerpt 1

The conveyor belt system has two conveyors. Conveyor 1 has priority and moves continuously when the conveyor belt system is turned on. Conveyor 2 automatically pauses when the proximity sensor detects a package already travelling on conveyor 1. The conveyor belt system has its own power switch, and the factory also has a main power board to turn off all machines at the end of the day. For the conveyor belt system to operate, both the conveyor belt system and the main power board must be turned on. The conveyor belt system stops when the emergency stop button is activated.

Construct a logic gate circuit for conveyor 2, clearly labelling all inputs and outputs. Complete the corresponding truth table on the next page.

Logic gate circuit



Key

Input A = Main power board (on = 1)

Input B = Conveyor belt system (on = 1)

Input C = Proximity sensor (package detected = 1)

Input D = Emergency stop button (activated = 1)

E and F are intermediate input/output signals to the logic gates.

Output X = Power to conveyor 2 (belt on = 1)

Inputs				Intermediate signals		Output
A	**B**	**C**	**D**	**E**	**F**	**X**
0	0	0	0	0	1	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	1	0
0	1	0	1	0	0	0
0	1	1	0	0	0	0
0	1	1	1	0	0	0
1	0	0	0	0	1	0
1	0	0	1	0	0	0
1	0	1	0	0	0	0
1	0	1	1	0	0	0
1	1	0	0	1	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	1	0	0

Excerpt 2

Logic gate circuit